New Hampshire Volunteer Lake Assessment Program

2002 Interim Report for Pleasant Lake Deerfield

NHDES
Water Division
Watershed Management Bureau
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PLEASANT LAKE, DEERFIELD,** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a and are naturally found in lake ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.

  Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

  The historical data (the bottom graph) show that the 2002 chlorophyll-a mean is ***less than*** the state mean. Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** in-lake chlorophyll-a trend, meaning that the concentration has ***fluctuated*** since monitoring began.

For the 2003 Bi-Annual report, since there will have been at least 10 consecutive years of sample collection for the lake, we will conduct a statistical analysis of the data. This will allow us to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). It is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.

Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

The current year data (the upper graph) shows that the transparency ***decreased slightly*** from June to August this season.

The historical data (the bottom graph) show that the 2002 mean transparency is ***much greater than*** the state mean. Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** trend for in-lake transparency, meaning that the transparency has ***fluctuated*** since monitoring began. It is worthy to note that although the in-lake transparency has fluctuated over the years, the results have always remained well above the state mean.

Again, for the 2003 annual report, since there will have been at least 10 consecutive years of sample collection for the lake, we will conduct a statistical analysis of the data. This will allow us to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into the lake and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.

  The historical data for the epilimnion (upper layer) show that the 2002 total phosphorus mean is ***less than*** the state median. Overall, visual inspection of the historical data trend line for the epilimnion shows ***a relatively stable*** total phosphorus trend (with the exception of the 1994 sampling season), which means that the concentration has ***remained approximately the same (and less than the state median)*** in the epilimnion since monitoring began. We hope this trend continues!

The historical data for the hypolimnion (lower layer) show that the 2002 total phosphorus mean is ***less than*** the state median. Overall, visual inspection of the historical data trend line for the hypolimnion shows ***a variable*** total phosphorus trend, which means that the concentration has ***fluctuated*** in the hypolimnion since monitoring began. However, it is important to note that the annual mean total phosphorus concentration in the hypolimnion has generally ***been less than*** the state median since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake, please contact the VLAP Coordinator.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**

  Small amounts of the cyanobacterium ***Microcystis, Anabaena, and Lynbya*** were observed in the plankton sample this season. ***If present in large amounts, these species can be toxic to livestock, wildlife, pets, and humans*** (Refer to page 14 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation). Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. As with the summer of 2001, we observed that some lakes and ponds had cyanobacteria present during the 2002 summer season, likely due to the many warm and sunny days that occurred this summer, which may have accelerated algal and bacterial growth. In addition, the lower than normal amount of rainfall during the latter half of the summer, meant that the slow flushing rates resulted in less phosphorus exiting the lake outlet and more phosphorus being available for plankton growth.

  The presence of cyanobacteria serves as a reminder of the lake's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake by eliminating fertilizer use on lawns, keeping the lake shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

  In addition, residents should also observe the lake in September and October during the time of fall turnover (lake mixing) to document any blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into "surface scums" that accumulate in one section of the lake. If a fall bloom occurs, please contact the VLAP Coordinator.

- **Table 4: pH**

  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

  Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake pH.

- **Table 5: Acid Neutralizing Capacity**

  Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake has been monitored through VLAP.

  Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

- **Table 6: Conductivity**

  Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

  The conductivity was elevated in the **107 Inlet** on the **July 23rd** sampling event (Table 6). Typically, sources of elevated conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is also possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up in the inlets and resulted in elevated conductivity levels.

- **Table 8: Total Phosphorus**
  Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to page 17 of the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

- **Table 9: Dissolved Oxygen and Temperature Profile (current year)**
  Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was greater than **100%** saturation at **6.0** meters at the deep spot on the **July 25th** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also raise the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth of the photic zone (depth to which sunlight can penetrate into the water column) was approximately **7.15** meters on this date (as shown by the Secchi-disk transparency), and that the metalimnion (the layer of rapid decrease in water temperature and increase in density – a place where algae are often found) was located between approximately **6.0** and **10.0** meters, we suspect that an abundance of algae caused the oxygen super saturation.

- **Table 10: Historical Hypolimnetic Dissolved Oxygen**
  Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer).

  The dissolved oxygen concentration was ***high*** at the deep spot of the lake on the July sampling event (Table 10). As stratified lakes age, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion the phosphorus that is normally bound up in the sediment may be re-released into the water column.

In previous seasons, the dissolved oxygen concentration has been ***low*** in the hypolimnion in August and September. Depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses.

- **Table 11: Turbidity**
  Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the "Other Monitoring Parameters" section of this report for a more detailed explanation.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an ***excellent*** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an ***excellent*** job when collecting samples and submitting them to the laboratory this season! However, please remember to write the correct date on the sample bottles when samples are collected (please refer to comment below).

OTHER COMMENTS

- The samples that were collected in the big white bottles by the volunteer monitors on the **June 26th** sampling event were rejected for sample analysis when they were returned to the Limnology Center on **June 27th**. The Limnology Center staff believed that these samples were **more than 48 hours** old because the bottles were dated **June 24th**. For quality assurance and quality control purposes, the lab can not accept samples that are more than 48 hours old. The laboratory staff should have called you to verify the sample collection date before discarding the samples. We apologize for the lack of communication, and as a standard practice, the laboratory staff will no longer discard samples before contacting the volunteer monitors.

- The Pleasant Lake Watershed and Diagnostic Study Final Report was issued in September 2002! The results and recommendations of the study provide a basis for lake protection through watershed management. Watershed management activities should be the immediate goals of the lake association, towns, and watershed residents.

  Although this project was successful in accomplishing its goals, only upon the implementation of a watershed management program will this project be considered a complete success.

  Many watershed management recommendations were made by DES as the result of this study. These recommendations include conducting stream bracketing to identify sources of pollution in the watershed and monitoring the effectiveness of Best Management Practices recently installed in the watershed. Should your association need any guidance in order to conduct these tasks, please feel free to contact the VLAP Coordinator.

NOTES

- **Monitor's Note (6/26/02):** All brooks flowing fast and deep.

- **Monitor's Note (7/23/02):** 1 loon observed near dam. Clark's Brook, Philbrick Brook, and Loon Cove were all dry and no samples were taken. The Route 107 site had little flow – sample was still taken, but a small amount of sediment was observed in bottle. No deep spot sampling due to a severe thunder and lightning storm which occurred while anchored at the deep spot.

- **Biologist's Note (7/25/02):** No inlets sampled due to dry conditions.

- **Monitor's Note (8/27/02):** All brooks normally sampled were dry, except dam/outlet.

USEFUL RESOURCES

Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/sp/sp-8.htm

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm

The Lake Pocket Book. Prepared by The Terrene Institute, 2000. (internet: www.terrene.org, phone 800-726-4853)

Managing Lakes and Reservoirs, Third Edition, 2001. Prepared by the North American Lake Management Society (NALMS) and the Terrene Institute in cooperation with the U.S. Environmental Protection Agency. Copies are available from NALMS (internet: www.nalms.org, phone 608-233-2836), and the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Organizing Lake Users: A Practical Guide. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available form the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm

Use of Lakes or Streams for Domestic Water Supply, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/ws/ws-1-11.htm

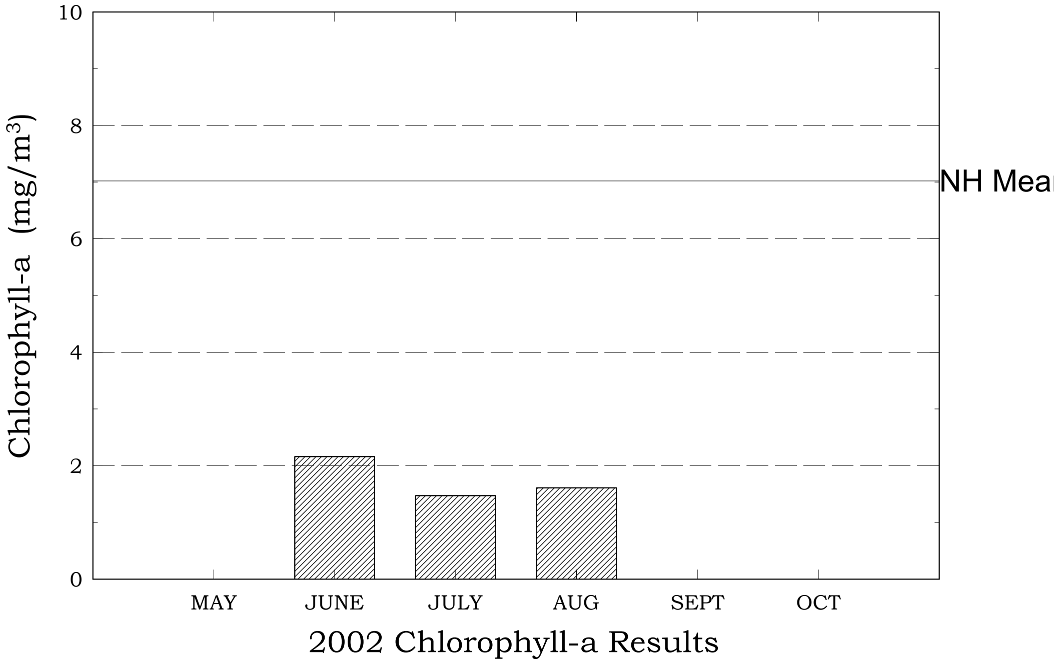
Water Milfoil, WD-BB-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-1.htm

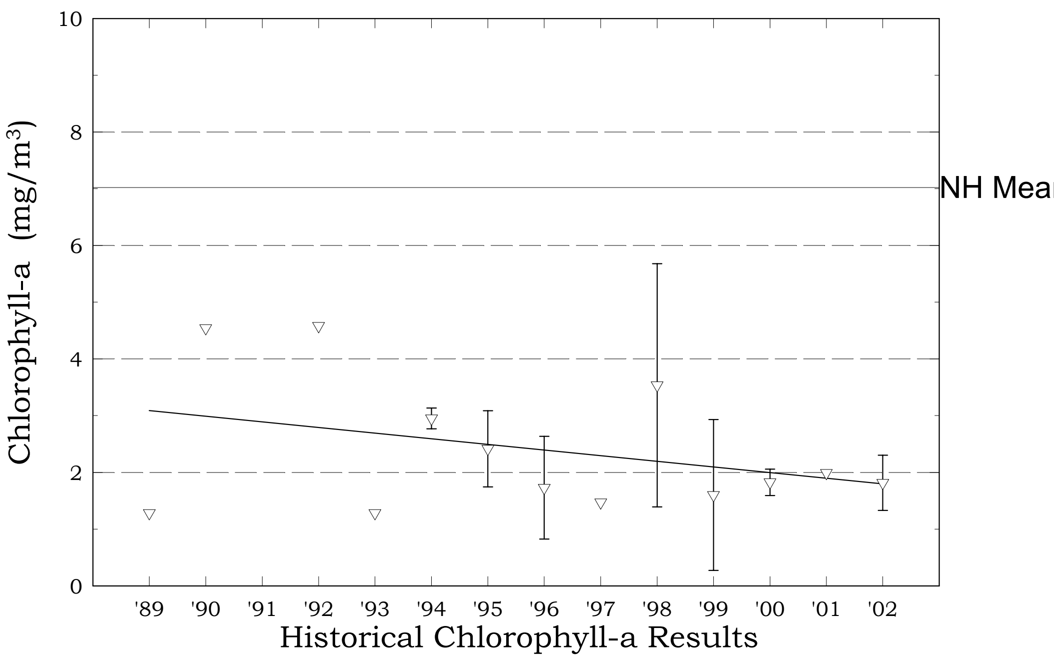
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm

Appendix A: Graphs

Pleasant Lake, Deerfield

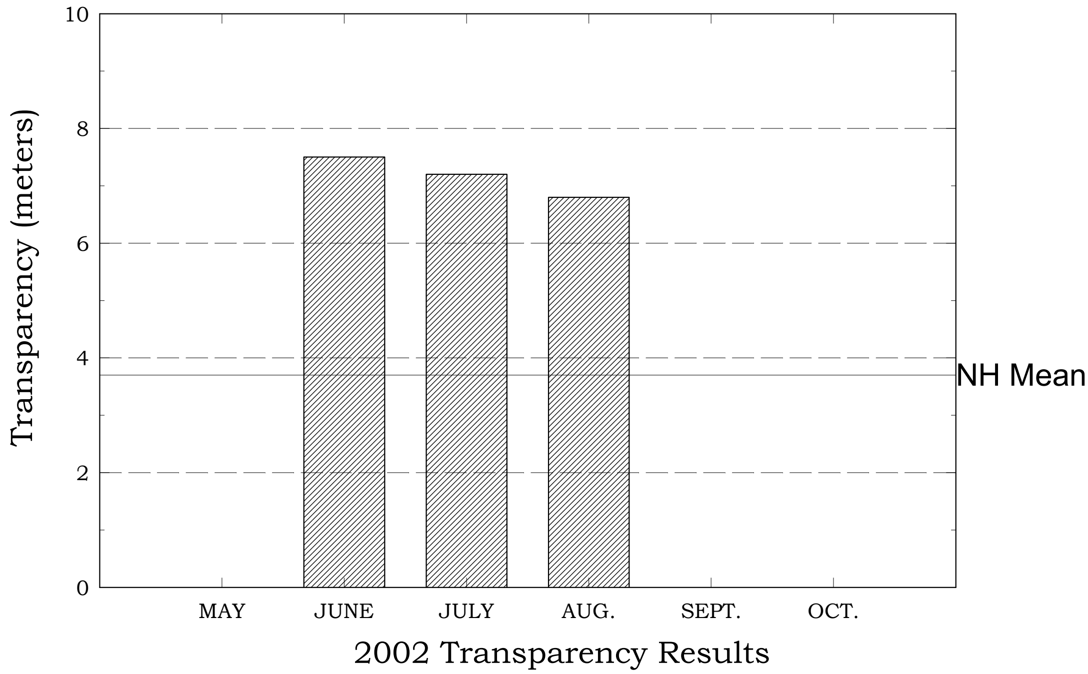
Figure 1. Monthly and Historical Chlorophyll-a Results

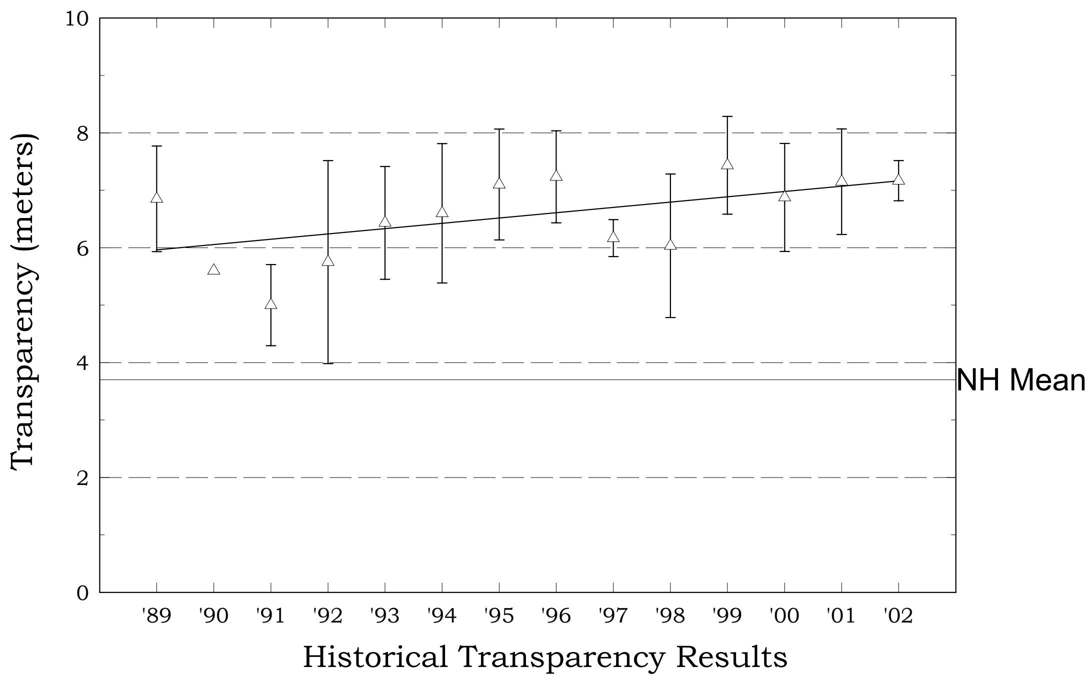




Pleasant Lake, Deerfield

Figure 2. Monthly and Historical Transparency Results





Pleasant Lake, Deerfield

Figure 3. Monthly and Historical Total Phosphorus Data.